

REMARKS

These Amendments and Remarks are filed in response to the final Office Action dated August 8, 2007. For the following reasons this amendment should be entered, the application allowed, and the case passed to issue. No new matter or considerations are introduced by this amendment. Support for the claim amendments can be found in previously considered, originally filed claims 2 and 3.

Claims 1 and 4-15 are pending in this application. Claims 1-15 are rejected. Claims 1, 4, 6, 7, 9, and 10 have been amended in this response. Claims 2 and 3 have been canceled in this response.

Claim Rejections Under 35 U.S.C. § 103

Claims 1-3, 6, and 8-10 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Kanai et al. (US 2001/0021468). This rejection is traversed, and reconsideration and withdrawal thereof respectfully requested. The following is a comparison between the present invention, as claimed and the cited prior art.

An aspect of the invention, per claim 1, is a fuel cell system having a fuel cell generating power as a result of chemical reactions between supplied gases, wherein a coolant flows in the fuel cell and undergoes a temperature increase as a result of absorbing waste heat produced by power generation in the fuel cell, a water tank, a humidifying device for humidifying at least one supplied gas by using water from the water tank, and a coolant temperature regulation device for regulating a temperature of the coolant flowing inside the fuel cell so as to control the temperature of the fuel cell. The fuel cell system comprises a defrosting device for melting ice in the water tank by applying heat of the coolant to the water tank. The defrosting device is disposed in the water tank and comprises a heat exchanger allowing heat exchange between the

coolant from the fuel cell and the ice in the water tank. A heater heats the coolant discharged from the defrosting device. A coolant recirculation passage allows a recirculation of the coolant through the defrosting device, the heater and the fuel cell. A flow generator generates a flow of the coolant heated by the heater from the heater to the defrosting device via the fuel cell and a controller controls a startup operation of the fuel cell system. The controller has the function of controlling the flow generator to generate a flow of coolant from the fuel cell to the defrosting device so as to melt ice in the water tank while the startup operation of the fuel cell system.

Another aspect of the invention, per claim 9, is a fuel cell system having a fuel cell generating power as a result of chemical reactions between supplied gases, wherein a coolant flows in the fuel cell and undergoes a temperature increase as a result of absorbing waste heat produced by power generation in the fuel cell, a water tank, a humidifying device for humidifying at least one supplied gas by using water from the water tank, and a coolant temperature regulation device for regulating a temperature of the coolant flowing inside the fuel cell so as to control the temperature of the fuel cell. The fuel cell system comprises a defrosting means for melting ice in the water tank by applying heat of the coolant to the water tank. The defrosting means is disposed in the water tank and comprises a heat exchanger means that allows heat exchange between the coolant from the fuel cell and the ice in the water tank. A heater heats the coolant discharged from the defrosting device. A coolant recirculation passage means allows a recirculation of the coolant through the defrosting means, the heater means and the fuel cell. A flow generating means generates a flow of the coolant heated by the heater means from the heater means to the defrosting means via the fuel cell and a control means controls the flow generator to generate a flow of coolant from the fuel cell to the defrosting means so as to melt ice in the water tank while a startup operation of the fuel cell system.

Another aspect of the invention, per claim 10, is a control method for controlling a fuel cell system. The fuel cell system has a fuel cell generating power as a result of chemical reactions between supplied gases, wherein a coolant flows in the fuel cell and undergoes a temperature increase as a result of absorbing waste heat produced by power generation in the fuel cell, a water tank, a humidifying device for humidifying at least one supplied gas by using water from the water tank, and a coolant temperature regulation device for regulating a temperature of the coolant flowing inside the fuel cell so as to control the temperature of the fuel cell. The control method comprises the steps of providing a defrosting device for melting ice in the water tank by applying heat of the coolant to the water tank. The defrosting device is disposed in the water tank and comprises a heat exchanger that allows heat exchange between the coolant from the fuel cell and the ice in the water tank. A heater for heating the coolant discharged from the defrosting device is provided. A coolant recirculation passage is provided to allow a recirculation of the coolant through the defrosting device, the heater and the fuel cell. A flow of coolant heated by the heater is generated from the heater to the defrosting device via the fuel cell so as to melt ice in the water tank while a startup operation of the fuel cell system.

The Examiner asserted that Kanai et al. disclose a fuel cell system comprising a fuel cell, a water-permeable-type humidifier, an auxiliary humidifier, radiator, condenser, water storage tank, and an injector. The Examiner considered applying heat of the coolant to the water tank to be functionally equivalent to using an electrical heater.

Kanai, however, is silent regarding a heater for heating the coolant discharged from the defrosting device and a flow generator for generating a flow of the coolant heated by the heater from the heater to the defrosting device via the fuel cell. Further, Kanai et al. fails to disclose a defrosting device for melting ice in the water tank by applying heat of the coolant to the water

tank, wherein the defrosting device is disposed in the water tank and comprises a heat exchanger allowing heat exchange between the coolant from the fuel cell and ice in the water tank.

The effect of the heater, the flow generator, and the defrosting device is described in the specification at page 18, line 26 – page 19, line 4 and FIG. 5A and FIG. 5C. Firstly the fuel cell 1 is heated to 0 °C using coolant heated by the heat exchanger 65. Second, the water tank 31 is heated to 0 °C by the defrosting device 61 using coolant from the fuel cell. When the temperature of the fuel cell 1 is less than 0 °C, the water in the water tank 31 does not exceed 0 °C. As a result, when the temperature of the fuel cell is less than 0 °C, a large amount of heat from the heat exchanger 65 is not used as heat of fusion to melt ice in the water tank. The heat of the heat exchanger 65 is used to increase the temperature of the ice in the water tank 31 to 0 °C (not as heat of fusion to melt ice). In this manner, it is possible to supply heat of fusion to melt ice in the water tank 31 by using only waste heat from the fuel cell 1 when a high level of power generation of the fuel cell 1 become possible after the temperature of the fuel cell exceeds the freezing point 0 °C (after the time t_2 in FIG. 5) (see page 14, lines 13-16 of the present specification). Therefore, it is possible to suppress hydrogen gas consumption because hydrogen gas consumption becomes smaller by the use of waste heat from the fuel cell 1.

FIG. 5A and FIG. 5C show that ice in the water tank is melted (FIG. 5C) in the time interval t_2 - t_4 only using power generation (FIG. 5A) of the fuel cell 1, not using heat from the combustor 66.

Kanai et al. teach an electric heater as an anti-freezing apparatus. This prior art technique prevents freezing of water by using an electrical heater to heat the water tank. However, an extremely large amount of power is used by the electrical heater in order to prevent freezing of

water. On the other hand, the present invention saves hydrogen (power source) by using waste heat from the fuel cell 1.

The Examiner's assertion that the claimed defrosting device and means are functionally equivalent to the Kanai et al. electric heater is traversed. The electrical heater of Kanai et al. does not suggest the use the claimed defrosting device and means, the heater, and the claimed arrangements of the devices and means, including the necessary coolant recirculation passages.

Kanai et al. do not suggest the claimed fuel cell systems and method for controlling a fuel cell system because Kanai et al. do not suggest the defrosting device is disposed in the water tank and comprises a heat exchanger allowing heat exchange between the coolant from the fuel cell and the ice in the water tank, a heater for heating the coolant discharged from the defrosting device, a coolant recirculation passage for allowing a recirculation of the coolant through the defrosting device, the heater and the fuel cell, and a flow generator for generating a flow of the coolant heated by the heater from the heater to the defrosting device via the fuel cell, as required by claim 1; the defrosting means is disposed in the water tank and comprises a heat exchanger means allowing heat exchange between the coolant from the fuel cell and the ice in the water tank, a heater means for heating the coolant discharged from the defrosting means, a coolant recirculation passage means for allowing a recirculation of the coolant through the defrosting means, the heater means and the fuel cell, and a flow generating means for generating a flow of the coolant heated by the heater mans from the heater means to the defrosting means via the fuel cell, as required by claim 9; and the defrosting device is disposed in the water tank and comprises a heat exchanger allowing heat exchange between the coolant from the fuel cell and ice in the water tank, providing a heater for heating the coolant discharged from the defrosting device, providing a coolant recirculation passage for allowing a recirculation of the coolant

through the defrosting device, the heater and the fuel cell, and generating a flow of coolant heated by the heater from the heater to the defrosting device via the fuel cell so as to melt ice in the water tank while a startup operation of the fuel cell system, as required by claim 10; nor does common sense dictate such a modification of Kanai et al. The Examiner has not provided any evidence that there would be any obvious benefit in making such a modification of Kanai et al. *See KSR Int'l Co. v. Teleflex, Inc.*, 500 U.S. ____ (No. 04-1350, April 30, 2007) at 20.

Claims 4, 5, 7, 11, and 14 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Kanai et al. in view of Ballantine et al. (U.S. 2003/0064262). This rejection is traversed, and reconsideration and withdrawal thereof respectfully requested.

The Examiner acknowledged that Kanai et al. do not disclose bypassing the radiator. The Examiner relied on Ballantine et al. to assert that it would have been obvious to incorporate a radiator bypass in the system of Kanai et al. to allow the heat generated by the fuel cell system to be controlled more efficiently.

The combination of Kanai et al. and Ballantine et al., however, do not suggest the claimed fuel cell system because Ballantine et al. do not cure the deficiencies of Kanai et al. Ballantine et al. teach a radiator for removing heat from the coolant of the fuel cell. Ballantine et al. do not disclose a defrosting device for melting ice in the water tank by applying heat of the coolant to the water tank, as required by claim 1.

Claims 12 and 13 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Kanai et al. in view of Ballantine et al. and further in view of Toohata et al. This rejection is traversed, and reconsideration and withdrawal thereof respectfully requested.

The Examiner acknowledged that Kanai et al. and Ballantine et al. do not disclose a heat exchanger integrated with a catalytic combustor and an electrically heated catalyst for increasing

the temperature of gasses supplied to the catalytic combustor and the heat generated by the catalytic combustor being applied to the to the coolant by the heat exchanger. The Examiner relied on the Toohata et al. teaching of a reformer which is heated by a burner and produces hydrogen, and heating water in the storage tank to assert that it would have been obvious to use a reformer and burner to supply the needed hydrogen and to use water tank heating.

The combination of Kanai et al., Ballantine et al., and Toohata et al., however, do not suggest the claimed fuel cell system because Toohata et al. do not cure the deficiencies of Kanai et al. and Ballantine et al. Toohata et al. teach a warm up system using discharge gas. Toohata et al. do not disclose a defrosting device for melting ice in the water tank by applying heat of the coolant to the water tank, as required by claim 1.

The dependent claims are allowable for at least the same reasons as claim 1 and further distinguish the claimed semiconductor device.

In view of the above amendments and remarks, Applicant submits that this amendment should be entered, the application allowed, and the case passed to issue. If there are any questions regarding this Amendment or the application in general, a telephone call to the undersigned would be appreciated to expedite the prosecution of the application.

To the extent necessary, a petition for an extension of time under 37 C.F.R. § 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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